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VOLUME IB (REV. A)
JSC-09874

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LARGE AREA CROP INVENTORY EXPERIMENT (LACIE)

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(E79-10109) LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). LEVEL 3 BASELINE, DATA ACQUISITION, PREPROCESSING AND TRANSMISSION SUBSYSTEM (DAPTS), FIELD DATA REQUIREMENTS, VOLUME 1B, REVISION A (NASA) 42 p HC A03/MF A01

NASA NOAA USDA

Level 3 Baseline

DATA ACQUISITION, PREPROCESSING AND TRANSMISSION SUBSYSTEM (DAPTS) - FIELD DATA REQUIREMENTS

NOTICE: THIS IS A BASELINED LEVEL 3 DOCUMENT CONTROLLED BY THE LACIE LEVEL 3 CHANGE CONTROL BOARD. ANY PROPOSED CHANGES SHOULD BE DOCUMENTED ON AN RECP FORM AND TRANSMITTED TO R. B. MACDONALD, LACIE MANAGER, NASA JSC CODE TF, HOUSTON, TEXAS 77058

National Aeronautics and Space Administration

LYNDON B. JOHNSON SPACE CENTER

Houston, Texas

December 1975

REVISIONS

REV LTR	CHANGE NO.	DESCRIPTION	DATE
		BASELINE ISSUE (Reference CCBD #III-0001, dated December 16, 1974)*	12-16-74
A	5M0049	Complete revision due to project rescoping. (LACIE change notices 5M0034 and 5M0053 are incorporated in this revision.)	12-16-75

*The changes required by the following RID's which were approved during the LACIE Project Review conducted December 3 through 5, 1974, have been incorporated into this baseline issue of the LACIE Level III Requirements Documents:

0-2 through 0-13, 0-15 through 0-29, and 0-31 through 0-46
1a-1, 1a-2, 1a-10, 1a-21, 1a-34, and 1a-36
1b-3 and 1b-6
1c-2, 1c-4, 1c-5, 1c-9, 1c-10, 1c-13, 1c-16, 1c-17, and 1c-20
2-12a, 2-13, 2-17, and 2-27

All other changes required by the remaining RID's approved during the Project Review will be incorporated by transmitting an RECP to the LACIE Level III Change Control Board for approval. Each RECP should be accompanied by the appropriate RID Closeout Form as described during the Project Review.

LIST OF EFFECTIVE PAGES

The current status of all pages in this document is as shown below:

Page No.		Authorizing CCBD No.
ii through v	Baseline 12/16/75	5M0049
vi	2/13/76	5M0066
vii	Baseline 12/16/75	5M0049
viii	2/13/76	5M0066
1-1 through 4-1	Baseline 12/16/75	5M0049
4-2 through 4-5	11/17/76	7M0033
4-6 through 4-11	2/13/76	5M0066
5-1 through 11-1	Baseline 12/16/75	5M0049

FOREWORD

Efficient management of the Large Area Crop Inventory Experiment (LACIE) dictates that effective controls of project activities be established. To provide a basis for effective control, documentation will be prepared, baselines will be established, and the changes to the baseline will be subsequently controlled by the proper management levels.

The specific control documents which will be used are defined in the LACIE Project Plan, LACIE-C00605. All elements of the LACIE Project must adhere to test baselined control documents, and, where it is considered that the requirements should be changed, the proper change request, accompanied by a full justification, must be submitted to the proper management level in accordance with established procedures. These documents will be maintained current by change notices and revisions, as required. Each change notice and/or revision will reference the applicable Change Control Board Directive (CCBD) which approved the change.

This document, LACIE-C00200, Volume IB, Revision A, defines the LACIE Data Acquisition, Preprocessing, and Transmission Subsystem (DAPTS) Field Data Requirements, and has been prepared in accordance with the "Instructions for Preparation of LACIE Requirements Documents," LACIE-00100, Revision C, dated November 20, 1974. "Full-Up System", as used in this document, is defined as the system required to accomplish LACIE Phase II. In general, the approach used in each section is to first specify the requirements of the Full-Up System and then to specify the requirements of any interim systems by reference to specific paragraphs in the Full-Up System requirements sections of the document. The LACIE Project Phases are defined in the LACIE Project Plan, LACIE-C00605.

The organization responsible for the implementation of each requirement definition in this document is specified on an individual requirement basis. Where the implementation responsibility applies to the complete section, the implementation responsibility is specified after the section title. A "section" for the purposes of designating implementation responsibility is defined as being any numbered paragraph and all subparagraphs. Where different implementation responsibilities apply to different portions of a section, the emplementation responsibility is specified on an individual paragraph or sentence basis, as applicable. All implementing

organizations designated shall accomplish their implementation activities in accordance with the requirements specified herein.

R. B. MacDonald
Manager, Large Area Crop Inventory Experiment

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GLOSSARY

AI	Analyst Interpreter
ARC	Ames Research Center
ASCS	Agricultural Stabilization and Conservation Service
ASVB	Applications System Verification Branch
CANS	Classification and Mensuration Subsystem
CAS	Crop Assessment Subsystem
CCB	Change Control Board
CCBD	Change Control Board Directive
CCT	Computer Compatible Tape
DAPTS	Data Acquisition, Preprocessing and Transmission Subsystem
EARTHSAT	Earth Satellite Corporation
EOD	Earth Observations Division
ERIM	Earth Resources Institute of Michigan
ERPO	Earth Resources Program Office
FSO	Facilities Support Office
Full-Up System	The System required to accomplish LACIE Phase II
GSFC	Goddard Space Flight Center
ICD	Interface Control Document
IE	Information Evaluation
Interim Systems	System Requirements to Accomplish Subphases of LACIE Phase I, excluding subphases IA and IB
ISRRS	Information Storage, Retrieval, and Reformatting Subsystem

ITS	Intensive Test Site
JSC	Lyndon B. Johnson Space Center
LACIE	Large Area Crop Inventory Experiment
LAI	Leaf Area Index
Landsat	Land Satellite (formerly Earth Resources Technology Satellite)
LARS	Laboratory for Applications of Remote Sensing
NASA	National Aeronautics and Space Administration
RT&EB	Research, Test, and Evaluation Branch
SPE	System Performance Evaluation
TAMU	Texas A&M University
TBD	To be Determined
USDA	United States Department of Agriculture
YES	Yield Estimate Subsystem

SECTION 1.0
FUNCTIONAL RESPONSIBILITIES

1.1 GENERAL

The Data Acquisition, Preprocessing, and Transmission Subsystem (DAPTS) is responsible for the acquisition, standard preprocessing, and transmission of all historical, field, and real-time meteorological data required for the LACIE. This document covers the requirements for field data, including aircraft data.

1.2 SPECIFIC

The specific responsibilities of DAPTS for field data, including aircraft data, include assimilating requirements for the data, acquiring the data, preprocessing the data, and transmitting the data to the Information Storage, Retrieval, and Reformatting Subsystem (ISRRS).

SECTION 2.0
APPLICABLE DOCUMENTS

The following documents are applicable to the extent herein specified:

A. LACIE - 00100, Instructions for Preparation of LACIE Subsystem Requirements Documents, Revision C, dated November 20, 1974.
B. LACIE Project Plan, LACIE-C00605, dated November 18, 1974.
C. USDA/NASA-JSC Interface Control Document, dated November 1975.
D. A Field Measurement Project for Remote Sensing of Wheat, dated TBD.

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SECTION 3.0
FUNCTIONAL FLOW DIAGRAMS

3.1 DAPTS FIELD DATA SUBSYSTEM DEVELOPMENT

3.1.1 Full-Up System
The functional flow diagram for the development of the portion of DAPTS related to field data is presented in figure 3-1.

3.1.2 Interim Systems
Not applicable.

3.2 DAPTS FIELD DATA SUBSYSTEM OPERATION

3.2.1 Full-Up System
The functional flow diagram for the operation of the portion of DAPTS related to field data is presented in figure 3-2. Functional subsystem interfaces and relationships are depicted in figure 3-3.

3.2.2 Interim Systems
Not applicable.

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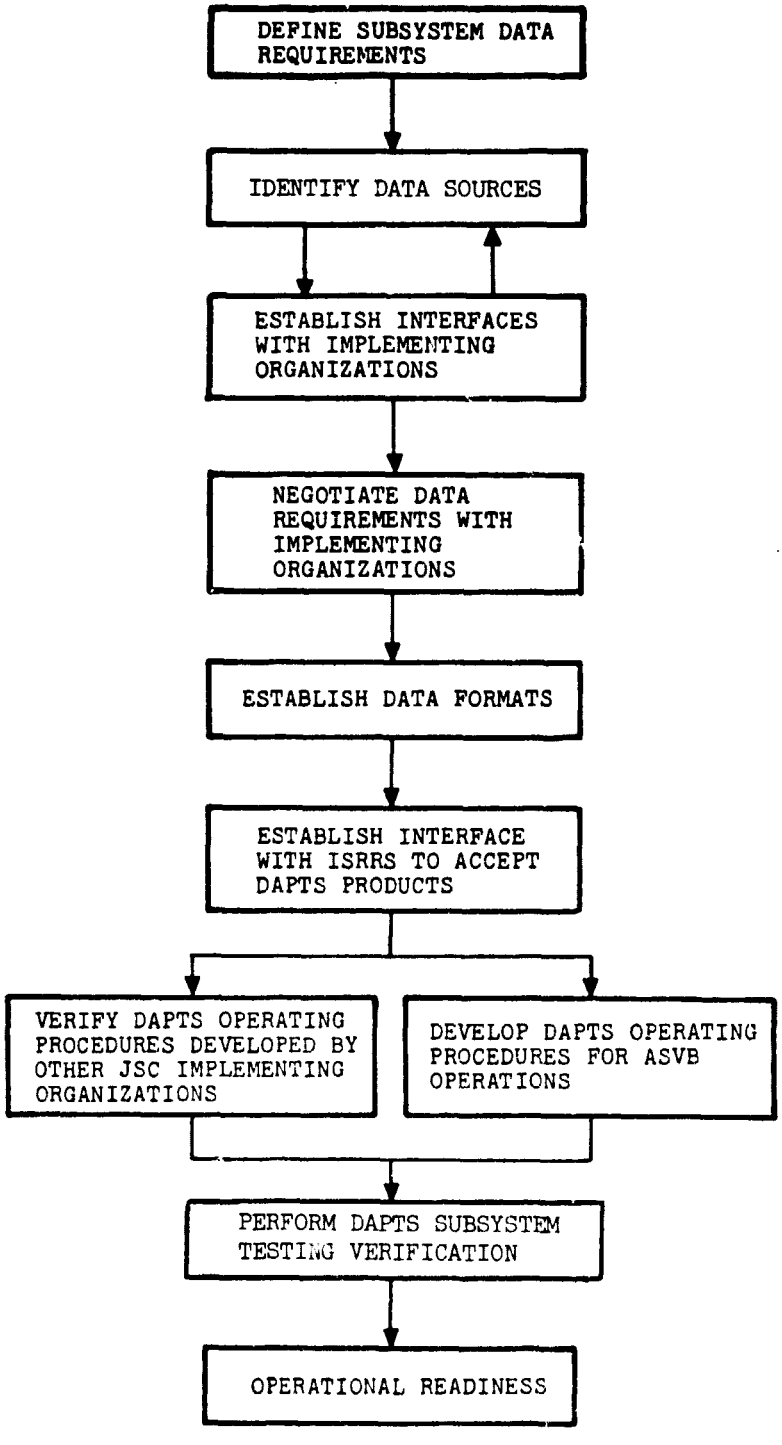

Figure 3-1.- Flow diagram of simplified DAPTS subsystem development.

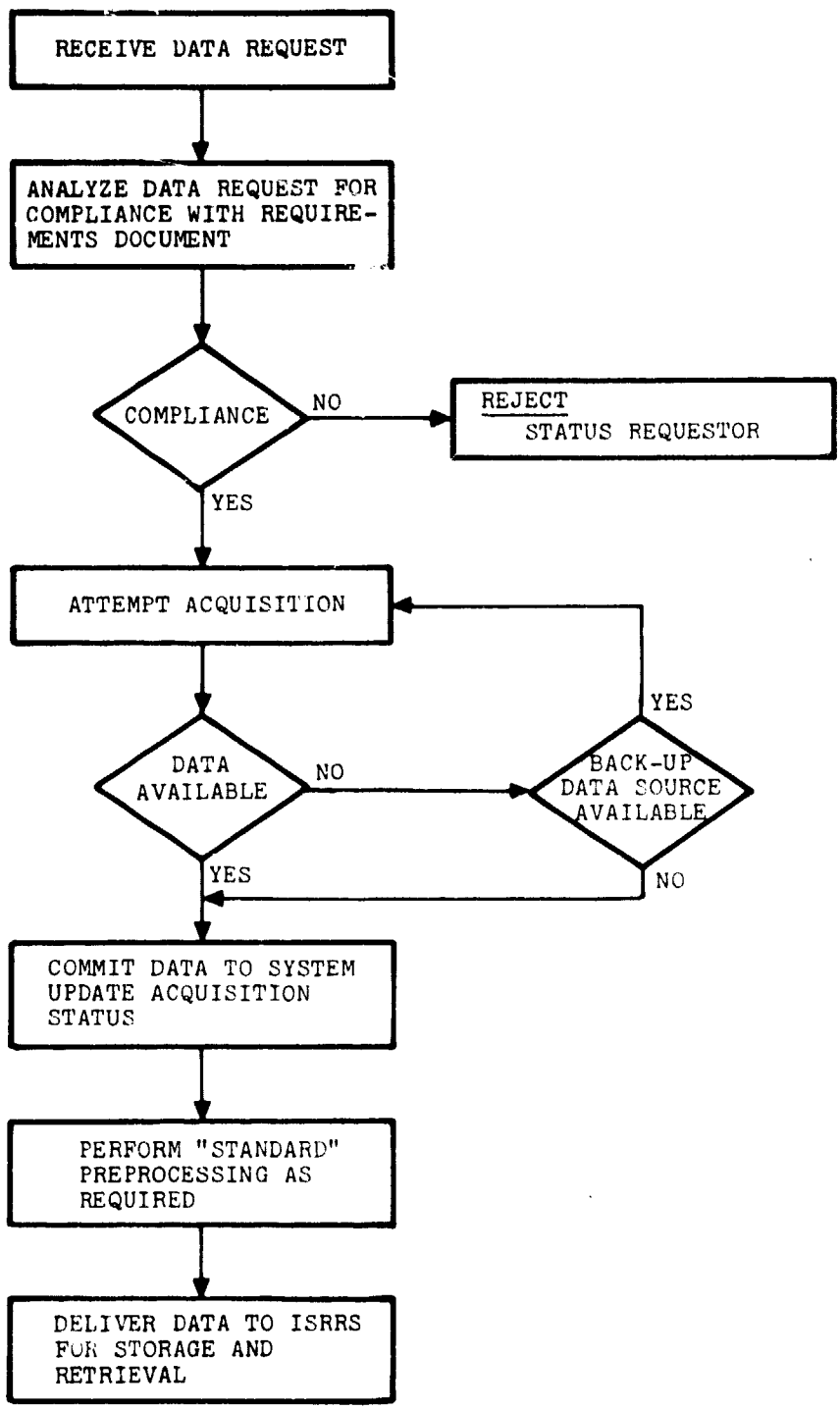

Figure 3-2.- Simplified DAPTS operations flow diagram.

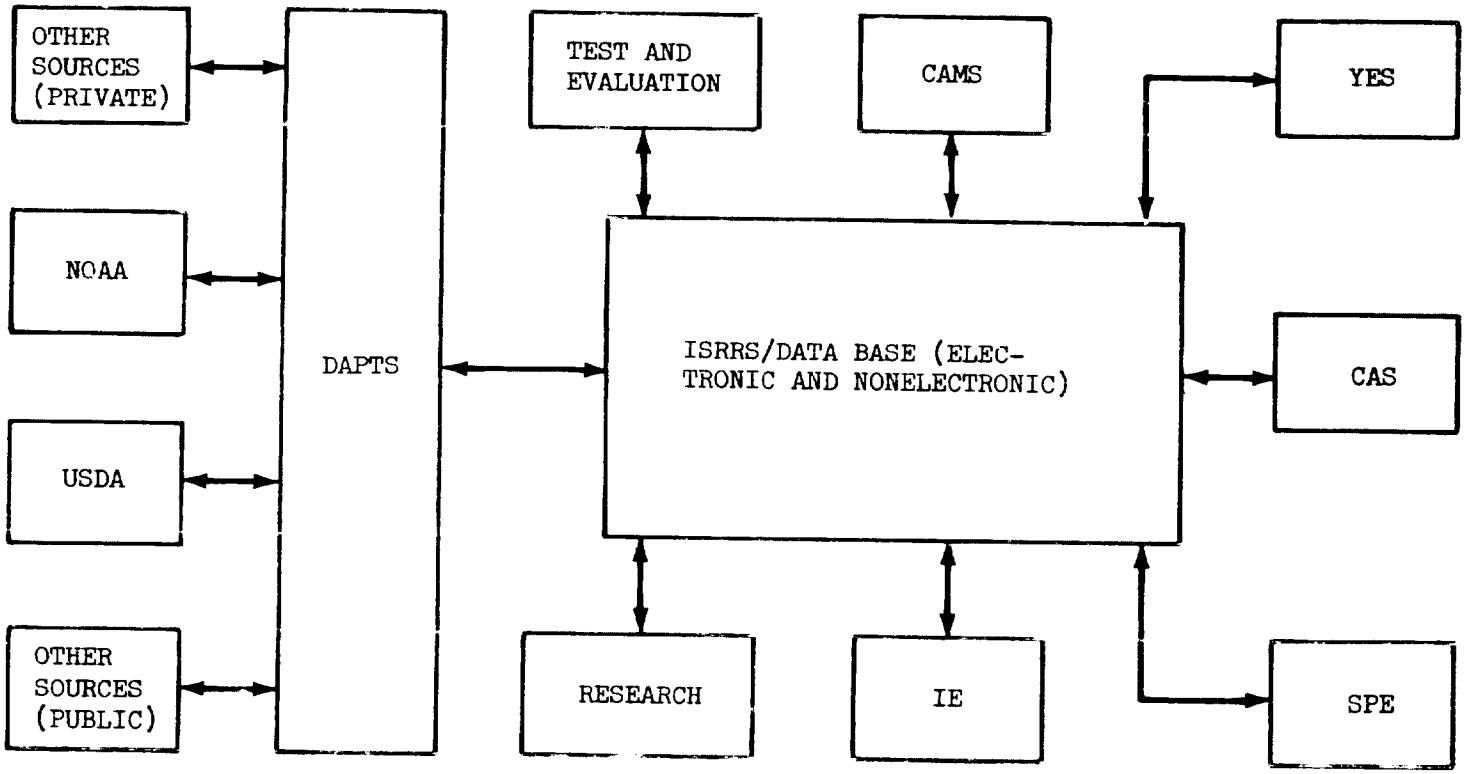

Figure 3-3.- Subsystem interfaces - DAPTS.

SECTION 4.0
REQUIREMENTS (CONSOLIDATED)

4.1 FULL-UP SYSTEM

4.1.1 Introduction

The LACIE Intensive Study Area Task Force has identified specific test sites within the U.S. and Canada from which field data will be required to support the LACIE Project. A common data base has been established for these sites and the data received will be stored in the LACIE Information Storage, Retrieval, and Reformatting Subsystem (ISRRS) for retrieval and use by other subsystems in support of LACIE applications, research, and test and evaluation.

4.1.2 Participating Organizations

4.1.2.1 NASA-Johnson Space Center, Science and Applications Directorate (S&AD), Earth Observation Division

4.1.2.1.1 Applications System Verification Branch.- In the Applications System Verification Branch (TF4), the Data Acquisition, Preprocessing, and Transmission Subsystem (DAPTS) has overall responsibility for collection of field data supporting LACIE. This includes requirements definition, operations, planning, procedures preparation, personnel training, data gathering, review, preprocessing, and transmittal to the ISRRS.

4.1.2.1.2 Facilities Support Office.- The Facilities Support Office (TF12) has responsibility for performing the following tasks in support of DAPTS.

A. Design, fabrication, testing, and calibration of specialized field measurements equipment used in support of various research data requirements
B. Providing cartographic support for preparation of ground truth maps of each Intensive Test Site

C. Acquiring maps and documentation; also, cataloging and storing nonelectronic field data used by other LACIE subsystems

4.1.2.2 NASA-Johnson Space Center, Earth Resources Program Office (ERPO).- The Operations Planning and Requirements Office of ERPO is responsible for arranging high altitude aerial photographic coverage of the Intensive Test Sites in response to an approved EOD flight request.

4.1.2.3 U.S. Department of Agriculture (USDA).- The USDA is responsible, through the Agricultural Stabilization and Conservation Service (ASCS) in the United States and the Ministry of Agriculture in Canada, for:

A. Preparation of data collection forms and procedures used by ASCS personnel
B. Training of ASCS and Canadian personnel performing the data collection task
C. Collection of field boundary, land use, crop condition, and yield data from all LACIE Intensive Test Sites
D. Checking returned data for accuracy and consistency

4.1.3 Test Site Description

Table 4-I presents information about the test sites chosen for the 1974-75 and subsequent crop years. Table 4-II presents those test sites in Canada used in the U.S./Canadian Spring Wheat Project. Of those sites, eight were chosen as ITS's for the 1975-76 crop year.

4.1.3.1 Location.- Thirty-nine test sites were chosen from eleven states in the U.S. and four provinces in Canada. The State, County, and geographical coordinates of the center of each test site are shown in table 4-I. The locations of the eight ITS's added in the provinces of Canada are shown in table 4-II.

4.1.3.2 Test site and orientation.- Test site sizes are 1 by 5, 1 by 6, 3 by 3, 5 by 6, 2 by 6, and 2 by 10 statute miles as shown in tables 4-I and 4-II. The Burke and Williams County sites in North Dakota are 5- by 6-mile sites made up by

TABLE 4-1.- LACIE INTENSIVE STUDY SITES

State or Province	County	Center coordinates		Site size in statute miles	Wheat type
		N. Lat.	W. Long.		
Colorado	Kit Carson	39°10.0'	102°15.0'	5 by 6	W
Indiana	Boone	40°05.7'	86°33.5'	3 by 3	W
Indiana	Madison	40°13.5'	85°37.5'	3 by 3	W
Indiana	Shelby	39°27.6'	85°47.2'	3 by 3	W
Kansas	Ellis	38°50.1'	99°13.0'	3 by 3	W
Kansas	Finney	38°10.2'	100°43.2'	5 by 6	W
Kansas	Morton	37°17.0'	101°54.0'	5 by 6	W
Kansas	Saline	38°52.0	97°28.4'	3 by 3	W
Minnesota	Kittson	48°35.0'	96°50.0'	5 by 6	S
Minnesota	Polk	47°49.0'	96°41.0'	5 by 6	S
Montana	Daniels	48°40.0'	105°10.0'	5 by 6	S&W
Montana	Hill	48°42.0'	109°55.0'	2 by 6	S&W
Nebraska	Adams	40°30.0'	98°30.0'	5 by 6	W
Nebraska	Hayes	40°30.0'	101°15.0'	5 by 6	W
Nebraska	Kimball	41°18.0'	103°30.0'	5 by 6	W
N. Dakota	Burke	48°53.2'	102°10.0'	5 by 6	S
N. Dakota	Ransom	46°25.0'	97°50.0'	5 by 6	S
N. Dakota	Rolette	48°40.0'	99°35.0'	5 by 6	S
N. Dakota	Williams	48°19.2'	103°24.7'	5 by 6	S
Oklahoma	Kay	36°50.0'	97°20.0'	5 by 6	W
Oklahoma	Kingfisher	35°50.0'	97°50.0'	5 by 6	W
Oklahoma	Kiowa	34°55.0'	99°00.0'	5 by 6	W
S. Dakota	Hand 1	44°35.0'	98°58.0'	5 by 6	S&W
S. Dakota	Harding	45°45.0'	103°05.0'	5 by 6	S&W
S. Dakota	Roberts	45°40.0'	97°00.0'	5 by 6	S&W
Texas	Jones	32°50.0'	100°05.0'	5 by 6	W
Texas	Oldham	35°15.0'	102°32.0'	3 by 3	W
Texas	Randall	35°09.5'	102°04.4'	3 by 3	W
Washington	Whitman 2	46°50.4'	117°48.3'	3 by 3	S&W
Saskatchewan	Delisle	51°55.0'	107°28.0'	2 by 10	S
Saskatchewan	Swift Current	50°19.0'	107°53.0'	2 by 10	S

S = spring, W = winter

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TABLE 4-II.- INTENSIVE STUDY SITES ADDED FOR 1975-76 CROP YEAR

Province	County	Center coordinates		US/CA	Site size in statute miles	Wheat type
		N. Lat.	W. Long.			
Alberta	Ft. Saskatchewan	53°38'	113°07'	Y	2 by 10	S
Alberta	Lethbridge	49°30'	112°48'	Y	2 by 10	S
Alberta	Olds	51°54'	113°32'	Y	2 by 10	S
British Columbia	Dawson Creek	55°48'	120°12'	Y	2 by 10	S
Manitoba	Starbuck	49°47'	97°29'	Y	2 by 10	S
Manitoba	Stony Mountain	50°04'	97°21'	Y	2 by 10	S
Saskatchewan	Altona	49°12'	97°38'	Y	1 by 5	S
Saskatchewan	Melfort	52°48'	104°44'	Y	2 by 10	S

adding a 3- by 6-mile LACIE site used in an earlier USDA project.

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4.1.3.3 Wheat types.- The type of wheat growing in each test site is shown in table 4-I. Specific wheat varieties and other crops grown in each test site will be identified during the land use inventory.

4.1.3.4 Cropping and farming practices.- A report on each Intensive Test Site is in preparation as a guide to analysts studying each area. This report will cover items of general interest such as climatology, cropping practices, mean crop calendars, soil types, etc. The report will be delivered to the ISRRS for filing and storage.

4.1.4 Data Acquisition

The following types of data are to be collected from the LACIE Intensive Test Sites:

A. Field boundary locations
B. Field identification
C. Test site aerial photography
D. Wheat yield
E. Periodic crop condition surveys
F. Field measurements program

4.1.4.1 Field boundary locations.- (Required by CAMS, RT&E; Category 1; implementation responsibility: DAPTS/USDA). DAPTS has been requested to determine the boundaries of all fields in all Intensive Test Sites. A field boundary survey will be conducted twice yearly for those test sites growing winter wheat. One survey will be scheduled for the fall just after planting and will identify fall-planted field boundaries only. Another survey in the spring, late enough for all spring crops to be planted, but before winter wheat harvest will identify boundaries of all fields. For those sites growing only spring wheat, one complete

survey will be conducted, after spring wheat planting.

In the U.S. the survey of each test site to establish boundaries will be accomplished by USDA survey teams. In Canada the survey will be done by the Canadian Department of Agriculture and reported to the USDA.

The approach used in the U.S. boundary survey is to provide the local ASCS office in each county containing an Intensive Test Site with one copy of the most recent high altitude aerial photography (1:24,000 scale), one copy of the most recent 1:24,000 scale transparent overlay showing field boundaries and numbers from the last survey, and 1:24,000 scale maps made from the overlay. New field boundaries are established by the ACS field survey teams. The data acquired during the boundary survey will consist of one set of the paper map made from the overlay (1:24,000 scale) marked with current field boundaries (Required by DAPTS; Category 1; implementation responsibility: DAPTS/USDA). This marked-up map will be received by DAPTS. After review for completeness and accuracy, the map will be filed in DAPTS until current, semi-controlled high altitude photos are received for construction of overlays. When overlays are complete, the marked-up maps will be delivered to the nonelectronic ISRRS for storage.

4.1.4.2 Field identification.- DAPTS has been requested to identify the vegetation growing in all fields in all Intensive Test Sites once yearly, after spring crops have been planted. In addition, a survey of those sites growing winter wheat was requested in the fall to identify fall-planted crops (Required by CAMS, RT&E; Category 1; implementation responsibility: DAPTS/USDA). This survey will be performed concurrently with the field boundary surveys of section 4.1.4.1. The data acquired during the field identification survey will consist of the following entries on the "LACIE Ground Truth Inventory Form" for each field surveyed in each test site.

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A. Field number (from field boundary photos)
B. Field acreage (measured)
C. Land use crop code (A three-digit code used to identify the crop and variety in each field)
D. Whether or not the field is irrigated and what type irrigation is used
E. Whether or not the field is fertilized and with what (if known)
F. Planting date

(Required by DAPTS; Category 1; implementation responsibility: DAPTS/USDA).

One set of completed inventory forms will be received by DAPTS at the same time as the marked-up aerial photos of section 4.1.4.1. After a review for completeness and accuracy, the forms will be matched against the aerial photos and maps to spot check field numbering and acreage. One copy of the checked inventory forms remains in DAPTS for future work. The original forms are forwarded to the nonelectronic ISRRS for storage.

4.1.4.3 Test site aerial photography.- High altitude photographic missions will be scheduled once yearly over all U.S. sites, late enough in the crop season for all spring crops to be planted but before winter wheat harvest. For the southern test sites this is in the period of mid-May to mid-June. For the northern sites, mid-June to late July is the best data acquisition time. Aerial photography of the Canadian sites will be provided by the USDA (Required by Research and DAPTS; Category 1; implementation responsibility: DAPTS/ERPO/USDA).

Aerial photography will be acquired over each U.S. Intensive Test Site with the NASA-JSC WB-57 or the Ames Reasearch Center U-2 aircraft. Flight request inputs for these missions are as follows:

A. Test site center point latitude and longitude
B. Photo acquisition time windows for each site
C. Altitude - 60 000 feet

D. Flight line direction - E-W
E. Cloud cover - less than 30 percent
F. Sun angle - greater than 20°
G. Snow cover - none
H. Film - color IR
I. Sensor - RC8 or RC10 metric camera
J. Overlap - 60 percent forward
K. Three frames per site minimum - one over center point coordinates, one prior, and one immediately after

After film processing and technical review by Aircraft Operations, the following data products from each Intensive Test Site will be delivered to the DAPTS.

A. Original or duplicate of original frames - 9-inch format
B. One copy positive transparencies, contact scale

(Required by DAPTS; Category 1; implementation responsibility: DAPTS/ERPO)

DAPTS will deliver original or duplicate original frames to the FSO which will produce a semi-controlled 1:24,000 mosaic of each Intensive Test Site (Required by T&E; Category 1; implementation responsibility: DAPTS/NASA-S&AD-FSO). On completion of mosaic preparation FSO will use the mosaics, the ASCS marked-up field boundary photos of paragraph 4.1.4.1 and the "LACIE Ground Truth Inventory Forms" of paragraph 4.1.4.2 to produce 1:24,000 scale transparent overlay for each Intensive Test Site keyed to the current aerial photography showing field boundaries and identification numbers (Required by CAMS and T&E; Category 1; implementation responsibilities: DAPTS/NASA-S&AD-FSO).

Mosaics and overlays will be delivered to ISRRS as completed.

4.1.4.4 Wheat yield.- A yield determination will be made for selected fields in each Intensive Test Site in the U.S., after wheat harvest. This corresponds to mid-June to late August, dependent on test site location and the type of

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wheat grown. (Required by YES Research; Category 2; implementation responsibility: DAPTS/USDA).

The following preharvest data will be collected and entered on the "Wheat Yield Determination" form.

A. Field number (from ASCS boundary photos) of the TBD fields selected.
B. Stand quality evaluation
C. Comments on yield influencing factors
D. 35-mm handheld photograph

The following post-harvest data are to be collected and entered on the same form.

A. Approximate harvest date
B. Wheat yield in bushels per acre

(Required by DAPTS; Category 1; implementation responsibility: DAPTS/USDA).

One set of completed yield determination forms will be received by DAPTS after wheat harvest in each test site. After review these forms will be delivered to the nonelectronic ISRRS for storage.

4.1.4.5 Crop condition survey.- Crop condition data will be acquired at 18-day intervals, synchronous with Landsat passes over each test site (Required by YES, T&E; Category 1; implementation responsibility: DAPTS/USDA).

Winter wheat sites will begin monitoring activity in April. Activity in areas growing spring wheat will begin in May. All monitoring will be completed with harvest. Fields to be monitored during the growing season will be selected using land use inventory data for each Intensive Test Site. Approximately 50 fields per site will be selected.

In the U.S., the crop condition survey will be accomplished by USDA personnel. In Canada, data will be collected by Canadian Department of Agriculture personnel and forwarded to USDA.

The following data are to be acquired from the selected fields in each test site:

A. Growth stage - 11 stages are provided; from unplanted through harvested.
B. Ground cover (percent) - Estimated, based on a vertical view of the field; five stages, 0 to 100 percent.
C. Plant height - Average plant height in inches for the field.
D. Surface moisture - Qualitative estimate, based on four stages of moisture level; dry to standing water.
E. Weed growth - Estimated, based on four stages of weed infestation; negligible to heavy.
F. Field operations - Covers basic conditions for fields not containing growing crops; 14 operations covered.
G. Growth/yield detractants - 15 detractants to growth or final yield can be identified.
H. Stand quality rating - Estimated, based on other fields in the site. Five stages, poor to excellent.
I. Vertical color photograph with site and field identification, photo location, scale, and calibrated reflectance plate. Acquired at U.S. site only.
J. Rainfall in inches from network of rainfall gages (1/sq. mile) spaced over the test site and read after rainfall. Rainfall date also reported; acquired at U.S. sites only.
K. Atmospheric optical depth at the time of Landsat-2 overpass is measured (weather conditions permitting) using equipment provided by NASA-JSC/EOD. Acquired at U.S. sites only.

One set of completed periodic survey forms will be returned to DAPTS every 18 days from every test site. After review, the forms will be forwarded to the nonelectronic ISRRS for storage.

4.1.4.6 Field Measurements Program.- (Required by Research; Category 2; Implementation Responsibility: DAPTS/NASA - S&AD-PSO). The Field Measurements Program conducted by

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Research in support of LACIE utilizes Intensive Test Sites in the U.S. as locations in which ASCS collected crop information is supplemented by extensive spectral reflectance, radiance, and other measurements using ground based and airborne equipment. The intensive test sites used in this program are designated as "Supersites" and consist of the following locations:

A. 1973-74 crop year - Randall County, Texas
B. 1974-75 crop year - Finney County, Kansas
   Williams County,
   North Dakota
C. 1975-76 crop year - Finney County, Kansas
   Williams County,
   North Dakota
   Hand County #1,
   South Dakota

The effect on the ASCS of raising an intensive test site to supersite status is:

A. To increase the frequency of periodic observations of crop development from 18 to 9 days during that part of the growing season when field measurement data are acquired
B. To increase the number of fields periodically observed from 50 to a maximum of 80.

The Field Measurements Program is under the technical direction of LARS with participation by ERIM, TAMU, and RT&EB. Program management is provided by RT&EB. Detailed technical objectives, a description of the data to be acquired, and data processing information is presented in "Field Measurements Research for Remote Sensing of Wheat", Project Plan, August 1, 1975.

Copies of all data acquired will be delivered to ISRRS for storage and retrieval.

4.2 INTERIM SYSTEMS

Not applicable.

SECTION 5.0
INPUT REQUIREMENTS

Inputs required by DAPTS from the other LACIE functional elements are defined in the following subparagraphs.

5.1 FULL-UP SYSTEM

5.1.1 DAPTS
(Required by DAPTS; Category 1; implementation responsibility: LACIE RT&EB). One copy of all work statements, contracts, interim and final reports, and any raw data submitted in support of research tasks performed or funded by the LACIE RT&EB are required by DAPTS for transmittal to ISRRS.

5.1.2 CAMS
Not applicable.

5.1.3 YES
Not applicable.

5.1.4 CAS
Not applicable.

5.1.5 ISRRS
Not applicable.

5.1.6 SPE-EA
Not applicable.

5.1.7 IE
Not applicable.

5.1.8 Research
Not applicable.

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5.1.9 Test and Evaluation
Not applicable.

5.2 INTERIM SYSTEMS
Not applicable.

SECTION 6.0
OUTPUT REQUIREMENTS

Outputs from DAPTS which will be provided to the other LACIE functional elements are defined in the following subparagraphs.

6.1 FULL-UP SYSTEM

6.1.1 DAPTS

The following interim output product will be generated by DAPTS for subsequent use in performing DAPTS functions.

6.1.1.1 USDA/NASA-JSC Interface Control Document.- (Required by DAPTS; Category 1; implementation responsibility: NASA-JSC/USDA). An Interface Control Document (ICD) will be negotiated between USDA and NASA-JSC prior to Phase II of LACIE to specify the physical interface for the transmission of LACIE field data between USDA and JSC. The ICD will specify the data parameters, sampling frequency and transmission format for all field data gathered by USDA.

6.1.2 CAMS

6.1.2.1 Ground Truth-CAMS.- (Required by CAMS; Category 1; implementation responsibility: DAPTS/S&AD-FSO/USDA).

DAPTS will provide the following data for each LACIE Intensive Test Site.

A. One copy of a 1:24,000 scale rectified B&W photo mosaic of each ITS. The photo-mosaic is to be made from high altitude aerial photography acquired once per year, just before wheat harvest.
B. One copy of a 1:24,000 scale transparent overlay registered to the photo-mosaic of paragraph A and delineating the boundaries of each field in the test site. Each field will be numbered and a tabular listing provided containing the following data:
   1. Field number
   2. Field acreage
   3. Crop and variety being grown
   4. Is field irrigated? If so, how?

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5. Is field fertilized? If so, how?
6. Planting date

These data are to be acquired once per crop year, after spring planting and before wheat harvest.

C. One copy of a 1:24,000 scale field boundary map registered to the photo-mosaic of paragraph A and delineating the boundaries of only those fields containing fall-planted crops in each Intensive Test Site in Texas, Kansas, Indiana, and Washington. Each field will be numbered and a tabular listing provided containing the information of paragraph B. These data are to be acquired once per crop year, after fall planting and before the beginning of dormancy.

D. One copy of Periodic Observation Data acquired at 18-day intervals from approximately 50 fields in each Intensive Test Site. Fields selected for observations must contain both wheat and other crops grown in the area. Fields selected must be 40 acres or larger in size. Adjacent fields planted in the same crop and divided by fences or farm roads may be grouped to obtain a 40-acre or larger area, if necessary. Data are required from the end of dormancy for fall planted crops or spring crop plantings until harvest. Data are to be acquired concurrent with Landsat-2 overpasses. The following data are required in tabular form:
   1. Growth stage
   2. Percent ground cover
   3. Plant height
   4. Surface moisture
   5. Weed growth
   6. Field operations
   7. Growth/yield detractants
   8. Stand quality rating
   9. Vertical color photos
   10. Observation date
   11. General comments on field and test site conditions

6.1.3 YES

6.1.3.1 Field data requirements.- (Required by YES; Category 1; implementation responsibility: DAPTS/USDA). To support the refinement of crop calendars and testing of yield prediction methods, YES requires that certain crop measurements and observations be made at regular intervals during the growing season. These observations will begin just prior to the end of the winter wheat dormancy period and will continue through winter and spring wheat harvest.

DAPTS will provide the following data from each LACIE Intensive Test Site (ITS).

A. Three copies of Periodic Observation Data acquired at 18-day intervals, concurrent with Landsat-2, from approximately 50 fields in each ITS. Fields selected for observations must contain both wheat and other crops grown in the area. Fields selected must be 40 acres or larger in size. Adjacent fields planted in the same crop and divided by fences or farm roads may be grouped to obtain a 40-acre or larger area, if necessary.

The following data are required in tabular form:

1. Frame numbers of vertical, hand-held 35-mm color photographs. (U.S. sites only)
2. Observation date
3. Growth stage (11 stages, preplanted to harvest)
4. Percent ground cover (5 stages, 0 to 100 percent)
5. Plant height (inches)
6. Surface moisture (four qualitative stages, dry to standing water)
7. Stand quality (five stages, poor to excellent)
8. Land use designation code
9. Weed infestation (five stages, negligible to very heavy infestation)
10. Current field operations (14 categories)

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11. Growth/yield detractants (12 categories)
12. General comments on field and test site conditions
13. Rainfall in inches from a network of rainfall gages (1 per sq. mi) spaced over the test site and read after each rainfall, acquired at U.S. sites only

B. Three copies of wheat yield data acquired just prior to harvest from approximately 10 wheat fields in each U.S. Intensive Test Site. The fields selected for yield determination must be a subset of the 50 fields monitored during the crop year under paragraph A and should represent both average and extreme conditions of yield within the site. The following data are required in tabular form for each field observed.
1. Observation date
2. Harvest date
3. Field number
4. Stand quality rating (five categories, poor to excellent)
5. ASCS observers yield estimate (bushels per acre)
6. Farmers yield estimate (bushels per acre)
7. Yield based on sample weight (bushels per acre)
8. Federal Crop Insurance Corporation (FCIC) yield determination (bushels per acre)
9. General comments (winter kill, stressed versus unstressed)

6.1.3.2 Super site field data.- (Required by YES; Category 2; implementation responsibility: DAPTS/USDA/RTEB).
For the 1974-75 and subsequent crop years, additional field data are required by the YES. These data include the Haun Index, Leaf Area Index, and Plant dry weight. These data will be acquired at 18-day intervals, synchronous with Landsat-2 coverage over each of the two Super Intensive Test Sites (Finney County, Kansas and Williams County, North Dakota). Details relative to the procedures and

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techniques to be used in the development of these data products are TBD.

6.1.4 CAS

6.1.4.1 Ground-Truth-CAS.- (Required by CAS; Category 1; implementation responsibility: DAPTS/S&AD-FSO/USDA).
DAPTS will provide the following data for each LACIE Intensive Test Site.

A. One copy of a 1:24,000 scale rectified B&W photo-mosaic of each ITS. The photo-mosaic is to be made from high altitude aerial photography acquired once per year, just before wheat harvest.
B. One copy of a 1:24,000 scale transparent overlay registered to the photo-mosaic of paragraph A, and delineating the boundaries of each field in the test site. Each field will be numbered and a tabular listing provided containing the following data:
   1. Field number
   2. Field acreage
   3. Crop and variety being grown
   4. Is field irrigated? If so, how?
   5. Is field fertilized? If so, how?
   6. Planting date

These data are to be acquired once per crop year, after spring planting and before wheat harvest.

C. One copy of a 1:24,000 scale field boundary map registered to the photo-mosaic of paragraph A and delineating the boundaries of only those fields containing fall-planted crops in each Intensive Test Site in Texas, Kansas, Indiana, and Washington. Each field will be numbered and a tabular listing provided containing the information of paragraph B. These data are to be acquired once per crop year, after fall planting and before the beginning of dormancy.
D. One copy of Periodic Observation Data acquired at 18-day intervals from approximately 50 fields in each Intensive Test Site. Fields selected for observations must contain both wheat and

other crops grown in the area. Fields selected must be 40 acres or larger in size. Adjacent fields planted in the same crop and divided by fences or farm roads may be grouped to obtain a 40-acre or larger area, if necessary. Data are required from the end of dormancy for fall planted crops or spring crop plantings until harvest. Data are to be acquired concurrent with Landsat-2 overpasses. The following data are required in tabular form:

1. Growth stage
2. Percent ground cover
3. Plant height
4. Surface moisture
5. Weed growth
6. Field operations
7. Growth/yield detractants
8. Stand quality rating
9. Vertical color photos
10. Observation date
11. General comments on field and test site conditions

6.1.5 ISRRS

Not applicable.

6.1.6 SPE-EA

6.1.6.1 DAPTS field resource parameters.- (Required by SPE-EA; Category 2; implementation responsibility: DAPTS/USDA). Information on resources expended in the collection, processing, and delivery of field data to JSC is required on an as-requested basis.

6.1.7 IE

Not applicable.

6.1.8 Research

These data requirements for Research in support of LACIE have not been defined as of the publication date of this document revision. It should be noted that the expected number of requirements will impact DAPTS.

6.1.9 **Test and Evaluation**

The data requirements for test and evaluation have not been established as of this date. Again, as in the case of Research, these additional requirements will impact DAPTS.

SECTION 7.0
INTERFACE REQUIREMENTS (DOCUMENTS)

Each implementing organization shall comply with the interface requirements specified in the USDA/NASA-JSC Interface Control Document, dated November 1975.

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SECTION 8.0
OPERATIONAL REQUIREMENTS AFFECTING DESIGN

8.1 THROUGHPUT REQUIREMENTS

That portion of DAPTS responsible for transmission of field data must provide the capability to handle the following.

A. Spring land use and field boundary data from all fields in 29 Intensive Test Sites
B. Fall land use and field boundary data from selected fields in those test sites growing winter wheat
C. Aerial photography over all 29 Intensive Test Sites once per year
D. Crop condition observation data from selected fields in each test site at 18-day intervals throughout the growing season
E. Yield data from selected wheat fields in each U.S. LACIE ITS

8.2 RESPONSE REQUIREMENTS

The response requirements for the DAPTS are defined by the required data products, output formats, and delivery schedules of the LACIE subsystems using DAPTS products. Need dates for data products used in the operational area of each LACIE subsystem are defined in the Level IV DAPTS working schedules.

8.3 RELIABILITY REQUIREMENTS

Not applicable.

8.4 SECURITY REQUIREMENTS

A LACIE security plan shall be prepared by each organization designated with implementation responsibility. The plan for each implementing organization shall define the specific measures that will be utilized by that organization to comply with the LACIE security requirements. The LACIE security requirements shall be defined by the USDA and will be forwarded to the implementing organizations upon receipt by the LACIE Project Manager. Each implementing organization shall submit a plan for approval to the LACIE Level III Change Board within 90 days after receipt of the USDA security requirements.

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8.5 DELIVERY REQUIREMENTS

Not applicable.

8.6 QUALITY ASSURANCE REQUIREMENTS

A LACIE quality assurance plan is being prepared under the direction of the Quality Assurance Manager. Concurrent with this quality assurance plan, a quality assurance procedures document is being prepared. The procedures contained in the quality assurance procedures document have been prepared by the respective organizational elements and will be implemented by personnel within these organizations.

8.7 OTHER OPERATIONAL REQUIREMENTS

Not applicable.

SECTION 9.0
VERIFICATION REQUIREMENTS

Each organization designated with implementation responsibility shall prepare a LACIE Verification Plan, including a complete definition of the verification functions proposed for verification of the portion of LACIE for which they are responsible. Each organization shall submit a plan for approval to the LACIE Level III Change Board within 90 days after the requirements documents are baselined.

SECTION 10.0
RESEARCH REQUIREMENTS

None.

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SECTION 11.0
TEST AND EVALUATION REQUIREMENTS

None.